UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Mr. Larry Lawson, Director
Division of Water Program Coordination
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Mr. Lawson:

The United States Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Loads (TMDLs) for the aquatic life (benthic) use impairments on Goose Creek and Little River. The TMDLs were submitted to EPA for review in
March 2004. The TMDLs were established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address an impairment of water quality as identified in Virginia's 1998, Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDLs for the aquatic life use impairments satisfy each of these requirements.

Following the approval of these TMDLs, Virginia shall incorporate the TMDLs into the Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Peter Gold at (215) 814-5236.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Decision Rationale

Total Maximum Daily Loads for
the Aquatic Life Use Impairments on the Goose Creek Watershed

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDLs for the aquatic life use (benthic) impairments on Goose Creek and Little River. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

II. Background

The 246,000 acre Goose Creek Watershed is located in Fauquier and Loudon Counties. Goose Creek is the largest tributary to the Potomac River in Virginia downstream of the Shenandoah River. The TMDL addresses the main stem of Goose Creek and Little River. Agricultural and forested lands make up roughly 97% of the 246,000 acre watershed. The remainder of the watershed was made up of developed and transitional lands and quarries.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed Goose Creek (VAN-A08R) and Little River (VAN-A08R) on Virginia's 1998 Section 303(d) list as being unable to attain the general standard for the aquatic life use. Both of these waters were listed for primary contact use impairments from their failure to attain the bacteriological (fecal coliform) criteria as well. TMDLs have been developed to address the bacteriological impairments. This decision rationale will address the TMDLs for the

impairment of the general standard for the aquatic life use. The failure to attain this use was determined through biological assessments of the benthic macroinvertebrate community.

Virginia's 305(b)/303(d) guidance states that support of the aquatic life beneficial use is determined by the assessment of conventional pollutants (dissolved oxygen (DO), pH, and temperature); toxic pollutants in the water column, fish tissue, and sediments; and biological evaluation of benthic community data.[1] Therefore, a biological assessment of the benthic community can be used to determine a stream's compliance with the state's general standard for the aquatic life use. Virginia uses EPA's Rapid Bioassessment Protocol II (RBPII) to determine status of a stream's benthic macroinvertebrate community.[2] This approach evaluates the benthic macroinvertebrate community between a monitoring site and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.[3] The state is currently in the process of changing this methodology to a stream condition index approach.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological community of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as impaired and are placed on the Section 303(d) list of impaired waters.

During the 1998 assessment period, Goose Creek was identified as being moderately impaired. Sampling in the Fall of 1998 and Spring of 1999 indicated the stream was still moderately impaired. However, recent sampling has shown an improvement in the benthic community with the 2000 and 2002 assessments showing a slight impairment. Little River has been evaluated as slightly impaired or not impacted since the Spring of 1997. In the last biological assessment in 2000 Little River had its highest assessment score and was evaluated as containing a healthy benthic community. Sampling data shows that these streams are being only minimally impacted if at all.

The RBPII analysis assesses the health of the macroinvertebrate community of a stream. The analysis will inform the biologist if the stream's benthic community is impaired. However, it will not inform the biologist as to what is causing the degradation of the benthic community.

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[1]VADEQ. 1997. 1998 Water Quality Assessment Guidance for 305(b) Water Quality Report and 303(d) TMDL Priority List Report. Richmond, VA.

[2]Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

[3]Ibid 2

Additional analysis is required to determine the pollutants which are causing the impairment. TMDL development requires the identification of impairment causes and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.[4] A reference watershed approach was used to determine the stressors and the endpoints for the Goose Creek Watershed TMDLs. Numeric endpoints represent the water quality goals that are to be achieved through the implementation of the TMDLs which will allow the impaired waters to attain their designated uses. A reference watershed approach is based on selecting a non-impaired watershed that shares similar landuse, ecoregion, and geomorphological characteristics with the impaired watershed. The stream conditions and loadings in the reference stream are assumed to be the conditions needed for the impaired stream to attain standards.

To determine whether a stream was a suitable reference site for the monitored sites, the modelers evaluated the topography, soils, ecoregion, landuses, watershed size, and point source inventory of the potential reference site. A reference site candidate was removed if it was identified as moderately or severely impaired in the biomonitoring analysis. The Rapidan River was selected as the reference watershed for Goose Creek. These are both large watersheds, however, the Rapidan River is almost twice the size of Goose Creek. The Rapidan River was seen as an appropriate reference watershed since it was used as the biological reference station for the RBPII analysis. Catoctin Creek was the reference watershed for Little River.

The next step in the TMDL development process was to determine the loadings and stressors in the monitored and reference watersheds. Low DO, sedimentation, habitat modification, nutrients, and toxic pollutants were evaluated as possible stressors to the monitored streams. Ambient water quality monitoring on the streams documented temperature, DO, pH, turbidity, total suspended solids (TSS), nitrogen, and phosphorous.

To get a better understanding of the DO concentrations during the most critical periods, diurnal DO sampling was conducted on August 20-21, 2003, on both waters. During this study, DO concentrations were monitored every nine hours over a 24-hour period. These samples were taken in the summer when the lowest DO concentrations are expected to be found due to a combination of high water temperatures (lower solubility of oxygen) and low flows. The diurnal DO data also captures the impacts of respiration from primary producers on the stream system. During the evening and early morning hours, these organisms cease photosynthetic operations since there is no sunlight available and consume oxygen. All of the samples collected during this period had DO concentrations in compliance with the applicable criteria. The lowest concentrations were detected in the early morning hours at 4 a.m. in Little River and 5 a.m. on Goose Creek. This is expected since it is just before the daylight hours. Since there were no observed violations of the DO criteria, nutrients were removed as a possible stressor as well. Since the impacts of excessive nutrient loadings often manifest in low DO levels.

Toxicity testing was conducted for water samples collected from the impaired waters. The testing compared the survival and growth rates or fathead minnows (Pimephales promelas)

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[4]Ibid 2

and water fleas (Ceriodaphnia dubia) in water collected from the impaired sites with an unimpaired water source. The test did not document any statistically significant effects associated with fathead minnows or water fleas reared in water from the Goose Creek Watershed. Therefore, chronic toxicity was ruled out as a possible stressor to the watershed. In all of the sediment and water samples collected from the Goose Creek Watershed there was only one metal (arsenic) which was detected about its Probable Effects Limit. Arsenic was only detected above this concentration once and it was in the Spring of 1995. This strengthens the conclusion that toxicity is not impacting the benthic community of the Goose Creek Watershed.

Sediment was identified as the stressor of concern for several reasons. The benthic community of Goose Creek and Little River consisted of more sediment tolerant species than their respective reference watersheds. The data for Goose Creek demonstrated that it had a larger sediment load than the Rapidan River for flows under the 85th percentile. The sediment loads in the Little River were usually low and consistent with those of Catoctin Creek. By reducing the sediment load to the impaired waters the load of sediment bound nutrients and toxics will be reduced as well. It should also be kept in mind that these waters have been evaluated as minimally impacted or not impacted in their last assessments. Therefore, their loadings may be similar to those of a reference water.

The next step in developing these TMDLs was to determine the sediment (the stressor) loadings to the monitored and reference segments. The Generalized Watershed Loading Functions (GWLF) model was selected as the means to determine loadings to the streams. The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).[5] GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[6] Calculations are made for sediment based on daily water balance totals that are summed to give monthly values. To equate the reference watersheds with the monitored watersheds, the reference watersheds were decreased in size to that of the impaired watersheds in the model, the landuses were proportionally decreased based on the percent landuse distribution. Therefore, the landuse breakdown in the reference watershed remained constant.

Local rainfall and temperature data were needed to simulate the hydrology. The Dulles Airport (Goose Creek, Little River and Catoctin Creek) and Piedmont Research Station (Rapidan River) weather stations were used for these TMDLs. To insure that the models accurately predicted the stream flow the modeled flow results were compared to the observed flows, a process known as calibration. The models' parameters were adjusted based on these results to insure the most accurate representation of the system. The Goose Creek model was calibrated to the United States Geological Survey (USGS) gage 01644000 on Goose Creek. The Rapidan River and Catoctin Creek models were calibrated to USGS gages 01667500 and 01638480 on the Rapidan River and Catoctin Creek respectively. The Goose Creek model was then validated to

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[5]Ibid 2

[6]Ibid 2

USGS gage 01643700 on Goose Creek. In the validation process the parameters that were developed in the calibration remain constant and the model is run to a different time period or gage in the watershed to insure the simulated flow matches the observed flows. This works to insure that the model can be applied to periods other than what were used in the calibration.

Table 1 - Summarizes the Sediment Allocations for Goose Creek and Little River

Stream	Pollutant	TMDL (tons/yr)	WLA (tons/yr)	LA (tons/yr)	MOS*(tons/yr)
Goose Creek	Sediment	47,106	1,587	40,808	4,711
Little River	Sediment	5,470	105	4,818	547

* Virginia includes an explicit MOS by reserving the 10 percent of total loading to the MOS.

The United States Fish and Wildlife Service has been provided with copy of these TMDLs.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing aquatic life use (benthic) impairment TMDLs for Goose Creek and Little River. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

The impaired segments were listed as impaired due to a degradation of their benthic macroinvertebrate communities. As mentioned above, benthic assessments inform the biologist of an impairment, but they are unable to identify stressors conclusively. Therefore, a reference watershed approach was used to identify the stressors to these streams. Virginia has indicated that excessive levels of sediment have caused the degradation of the benthic communities in Goose Creek and Little River. The Commonwealth does not have numeric standards for sediment at this time. Therefore, the loadings obtained from the reference watersheds were used as the endpoints for these TMDLs. Its believed that if these streams can reduce their sediment loadings to that of the area weighted reference watershed, the impairment to the benthic communities will be relieved. The most recent bioassessments reveal that the benthic community on Little River may no longer be impaired and that the community on Goose Creek is only minimally impaired. The management practices that will be implemented in association with the fecal coliform TMDL will limit the annual sediment load to the impaired waters as well.

The GWLF model was used to determine the loading rates of the sediment to the streams from all point and nonpoint sources. The TMDL modelers determined the applicable stressor loading rates within each watershed. Data used in the model was obtained on a wide array of items, including landuses in the area, point sources in the watershed, weather, stream geometry, etc..

The GWLF model provides the ability to simulate runoff and sediment loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land). GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[7] To equate the reference watersheds with the monitored watersheds, the reference watersheds were decreased in size to that of the impaired stream in the model. Each landuse was decreased in equal proportion, insuring that the landuse breakdown in the reference watershed remained constant. Local rainfall and temperature data were needed to simulate the hydrology, this data was obtained from the Dulles Airport (Goose Creek and Catoctin Creek) and Piedmont Research Center (Rapidan River) weather stations. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of agricultural land, land slope, soil erodibility, and farming practices used in the area.[8] Parameters within the model account for these conditions and practices.

All of the TMDL models were calibrated to observed data collected from USGS gages (1990-2001) within the respective watershed. By calibrating to observed flow data collected from local gages the modelers are able to develop a strong calibration. EPA believes that using GWLF to model and allocate the sediment loadings to the impaired stream segments will ensure the attainment of the designated uses and water quality standards on these streams. For the Goose Creek TMDL the loadings and allocations were based on projected loads because of the large amount of development occurring within the watershed. It was believed that current loadings would not accurately reflect the stream conditions in the near future. This was not done for the Little River.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of nutrients and sediment to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There are a number of facilities holding National Pollutant Discharge Elimination System (NPDES) permits in the Goose Creek Watershed. There are nine individual permits to waste water treatment plants, one individual permit to a water treatment plant, 18 general permits for small treatment units, seven industrial stormwater permits, two non metallic mining general permits, two general permits for concrete plants and 42 stormwater permits for construction sites.

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[7]Ibid 2

[8]Ibid 2

The WLAs for the stormwater permits can be determined by multiplying the permitted flow by the permitted concentration of sediment by 365 days after making the appropriate unit conversions. The WLAs for the stormwater permits are based on the annual runoff from the regulated area and that runoff is then multiplied by the concentration after the appropriate unit conversions are made. There were five NPDES permitted facilities in the Little Creek watershed. All of these facilities were provided with WLAs in both TMDLs. The WLAs for the non-stormwater permits are provided in Table 2.

EPA regulations require that an approvable TMDL include individual waste load allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any NPDES permit that is inconsistent with the WLAs established for that point source.

Table 2 - TSS WLAs for Goose Creek and Little River

Stream	Permit Number	Facility	WLA (t/yr)
Goose Creek	VA0022802	Purcelville WWTP	91.5
Goose Creek	VA0024112	Foxcroft School	9.0
Goose Creek	VA0024759	US FEMA	16
Goose Creek	VA0024775	Middleburg WWTP	14.5
Goose Creek	VA0026212	Roundhill WWTP	38.0
Goose Creek	VA0027197	Notre Dame Academy	3.5
Goose Creek	VA0062189	St. Louis Community	19.5
Goose Creek	VA0080993	Goose Creek Industrial Park	2.5
Little River	VA0089133	Aldie WWTP	3.5
Goose Creek	VA002666	Goose Creek Water Treatment Plant	57.9
Goose Creek	VAG406015	Residence	0.046
Goose Creek	VAG406016	Business	0.046
Goose Creek	VAG406018	Residence	0.046
Little River	VAG406019	Residence	0.046
Goose Creek	VAG406020	Residence	0.046
Goose Creek	VAG406047	Residence	0.046
Goose Creek	VAG406069	Residence	0.046
Goose Creek	VAG406101	Residence	0.046

Goose Creek	VAG406113	Residence	0.046
Goose Creek	VAG406115	Residence	0.046
Goose Creek	VAG406116	Residence	0.046
Goose Creek	VAG406121	Residence	0.046
Goose Creek	VAG406135	Residence	0.046
Goose Creek	VAG406143	Residence	0.046
Goose Creek	VAG406146	Residence	0.046
Goose Creek	VAG406149	Residence	0.046
Goose Creek	VAG406170	Residence	0.046
Goose Creek	VAG406172	Business	0.046
Goose Creek	VAG406176	Residence	0.046
Goose Creek	VAG406193	Residence	0.046
Goose Creek	VAG406244	Residence	0.046
Goose Creek	VAG846011	Luck Stone-Leesburg	56.3
Goose Creek	VAG846016	Luck Stone-Goose Creek	90.1
Goose Creek	VAG110091	Virginia Concrete	1.2
Goose Creek	VAG110123	Cider and Shockey	3.8

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the GWLF model to represent the impaired watersheds. The GWLF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. GWLF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various landuses within the watershed. Table 3 provides the LA for all of the nonpoint sources of sediment.

Table 3 - LA for Sediment for Goose Creek and Little River

	Goose Creek		Little River	
Land Use	LA Sediment (tons/yr)	Percent Reduction	LA Sediment (lbs/yr)	Percent Reduction
Forest	998	0	266	0
Clear-Cut Timber	0.2	92	0.03	92
Select-Cut Timber	6	92	0.16	92
Cropland	1,166	30	288	37
Pasture	9,930	30	2,800	37
Developed Land	444	30	16	37
Streambank Erosion	31,860	62	1,414	37

Sediment Trapping	-4,440		N/A	

3) The TMDLs consider the impacts of background pollution.

The reference watershed approach inherently considers the impact of background pollutants by considering the sediment load from all landuses, including forested lands, within the impaired and reference watersheds.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the impaired segments is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[9]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition when the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The GWLF model was run over a multi-year period for the reference watershed to insure that it accounted for wide range of climatic conditions within the reference watershed. The allocations developed in the TMDL will therefore insure that the criteria is attained over a wide range of environmental conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Pollutant loadings also change during the year as vegetation grows making it more difficult for sediments to runoff. Consistent with

[9]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

the discussion regarding critical conditions, the GWLF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and modifying the soil loss equations based on the time of the year.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia includes an explicit MOS by allocating 10 percent of the total TMDL loading to the MOS.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. The practices that will be used in order to attain the bacterial reductions called for in the fecal coliform TMDL will also reduce the sediment loading to the impaired waters as well.

8) The TMDLs have been subject to public participation.

There were two public meetings held in accordance with the benthic TMDLs for Goose Creek and Little River. The meetings were held in the Loudon County Government Center in Leesburg, Virginia. The meetings were noticed in the Virginia Register and held on April 10, 2003 and December 11, 2003. Eighteen people attended the first meeting and thirteen attended the second. Each of the meetings were opened to a thirty-day comment period. No comments were received in association with the first meeting and three were received for the second.